RQF LEVEL 4

TRADE: Electronic and Telecommunication

MODULE CODE: ETEHM401

TEACHER'S GUIDE

Module name: HARDWARE MAINTENANCE OF OS BASED PROCESSING DEVICES

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2023

Contents

Acronyms

ADC: Analog-to-Digital Converter
AC: Alternating current
BIOS: Basic input output system
CPU: Central processing unit
CRT: Cathode ray tube
DAC: Digital-to-Analog Converter
DC: Direct current
DVI: digital visual interface
ESD: Electrostatic discharge
GPU: Graphics Processing Unit
GUI: Graphical User Interface
HDD: Hard Disk Drive
HDMI: High-Definition Multimedia Interface
HDMI: High-Definition Multimedia Interface
HDTV: high-definition television
IBM: International Business Machine
IC :Integrated circuits
IEEE: Institute of Electrical and Electronics Engineers
LAN: local area network
LCD: Liquid crystal display
LED: Light-emitting diode
NIC: Network interface cards
OLED: Organic Light-emitting diode
OS: Operating system
PPE: personal protective equipment
PS-2: Personal System/2.
QLED: quantum Light-emitting diode
RAM: Random Access memory
RJ: Registered jack
ROM: Read only memory
RTOS: Real-time operating systems
SD: Secure Digital
SMTP: Simple Mail Transfer Protocol
VGA: Video Graphics Array

Introduction

This module describes the knowledge, skills, and attitudes required to maintain hardware of OS based processing devices such as computer systems and mobile phones. At the end of this module, the learners will be able to Perform pre-maintenance activities, perform maintenance activities and perform post maintenance activities of the mentioned devices.

Module Code and Title : ETEHM401 MAINTAIN HARDWARE OF OS BASED PROCESSING DEVICES

Learning Outcome 1: Perform pre-maintenance activities
Learning Outcome 2: Perform maintenance activities: on computer system and mobile phones
Learning Outcome 3: Perform post-maintenance activities

Learning outcome 1: Perform pre-maintenance activities

Learning outcome 1: Perform pre-maintenance activities

Indicative contents (headings of indicative content from the module of the curriculum)
1.1: Introduction to OS hardware-based processing devices
1.2: Preparation of workplace
1.3: Selecting tools, materials, and equipment
1.4: Description of the diagnostic form of OS hardware-based devices

Duration: 10 hrs

Learning outcome 1 objectives:

By the end of the learning outcome, the trainees will be able to:

1. provide clearly an overview of hardware-based processing device in the context of OS.

2.prepare well the workplace according to the electronic workshop code of practices

3. select properly tools, materials, and equipment used for OS hardware-based device maintenance.

4. Describe clearly the diagnostic form used for OS hardware-based devices maintenance

Resources

Equipment	**Tools**	**Materials**
Digital multimeter, Air blower, Soldering station, Glue gun, Computer, PPE, Network Cable tester, LCD tester, Projector.	Screwdriver set, magnifying glass, soldering iron, Desoldering pump, Tweezer, Allen key set, ESD tools, plier sets.	Electronic components, Integrated circuits (IC), Electronic relay, Glue stick, Computer spare parts, Hard Disk Drive (HDD), Foam Cleaner, Thermal paste, Soldering paste, Desoldering

		wire, Soldering wire, marker pen

Advance preparation:

. provide safety guidelines

. Availability of repairing material, tools and equipment

. Proper preparation of working place

Indicative content 1.1: Introduction to OS hardware-based processing devices

- ✓ **Definitions:**
  - **Operating System (with types)**

An operating system (OS) is the program that, after being initially loaded into the computer by a boot program, manages all of the other application programs in a computer.

Windows, Linux, and Android are examples of operating systems that enable the user to use programs like MS Office, Notepad, and games on the computer or mobile phone.

Types of operating system

- **Batch Operating System**

This type of operating system does not interact with the computer directly. There is an operator which takes similar jobs having the same requirement and groups them into batches. It is the responsibility of the operator to sort jobs with similar needs.

Examples of Batch Operating Systems: Payroll Systems, Bank Statements, etc.

- **Multi-Programming System**

Multiprogramming Operating Systems can be simply illustrated as more than one program is present in the main memory and any one of them can be kept in execution. This is basically used for better execution of resources

- **Multi-Processing System**

Multi-Processing Operating System is a type of Operating System in which more than one CPU is used for the execution of resources. It betters the throughput of the System.

- **Multi-Tasking Operating System**

Multitasking Operating System is simply a multiprogramming Operating System with having facility of a Round-Robin Scheduling Algorithm. It can run multiple programs simultaneously.

There are two types of Multi-Tasking Systems which are listed below.

- Preemptive multi-tasking
- Cooperative multi-tasking

- **Time-Sharing Operating System**

Time-sharing is a logical extension of multiprogramming, A time-shared operating system allows multiple users to share computers simultaneously. With each action or order at a time the shared system becomes smaller, so only a little CPU time is required for each user. As the system rapidly switches from one user to another, each user is given the impression that the entire computer system is dedicated to its use, although it is being shared among multiple users.

- **Distributed Operating System**

A distributed OS is a recent advancement in the field of computer technology and is utilized all over the world that too with great pace. In a distributed OS, various computers are connected through a single communication channel. These independent computers have their memory unit and CPU and are known as loosely coupled systems. The system processes can be of different sizes and can perform different functions. The major benefit of such a type of operating system is that a user can access files that are not present on his system but in another connected system. In addition, remote access is available to the systems connected to this network.

- **Network Operating System**

An Operating system, which includes software and associated protocols to communicate with other computers via a network conveniently and cost-effectively, is called Network Operating System.
There are mainly two types of networks, one is peer-to-peer and another is client/server.

- **Real-Time Operating System**

Real-time **operating systems (RTOS)** are used in environments where a large number of events, mostly external to the computer system, must be accepted and processed in a short time or within certain deadlines. such applications are industrial control, telephone switching equipment, flight control, and real-time simulations. With an RTOS, the processing time is measured in tenths of seconds. This system is time-bound and has a fixed deadline. The processing in this type of system must occur within the specified constraints. Otherwise, This will lead to system failure.
Examples of real-time operating systems are airline traffic control systems, Command Control Systems, airline reservation systems, Heart pacemakers, Network Multimedia Systems, robots, etc.

- **Hardware system.**

Hardware refers to the external and internal devices and equipment that enable you to perform major functions such as input, output, storage, communication, processing, and more. There are two types of computer hardware: external and internal. External hardware devices include monitors, keyboards, printers, and scanners, whereas internal hardware devices include motherboards, hard drives, and RAM.

HARDWARE FUNCTION

The function of computer hardware components varies depending on the component in question. Hardware components you'll find in any system include things like the motherboard, CPU, RAM, hard drive and network cards. Each of them server different purposes and have different function

- **Motherboard**

The motherboard is the circuit board device which all hardware components must connect to in order to be able to communicate with one another. The motherboard connects and distributes information to all components along with managing power requirements.
Hardware components such as RAM, network cards, graphics cards and the CPU are all connected to the motherboard.

- **Processor (CPU)**

The central processing unit (CPU) carries out the actual computing work on a system. It's considered the brain of the system as it executes all the instructions necessary in order for the operating system to run and communicate with all software and hardware components.

- **Power Supply**

A PSU (power supply unit) device supplies internal components with power. It converts alternating current (AC) from the standard wall socket in to a more stable direct current (DC) which becomes usable by the computer components. Power supply units have varying voltage ratings depending on the power requirements of any given system. The 3 main voltage ratings are 12V, 5V and 3.3V.

- **Fans and Heat Sinks**

Most computers have fans which help to keep system components cool. These fans are powered by the PSU and ensure the system runs reliably. When a system boots, you'll often hear fans run at maximum speed temporarily until the operating system and software instructs them to slow down.
Heat sinks server the same purpose and are placed over CPUs or graphic cards in order to keep them from overheating.

- **BIOS**

The BIOS (stands for 'basic input/output system) is read only memory located on all motherboards that allows users to access and set up the computer system at the most basic level (through a command line interface).

- **Hard Drive**

All systems need to be able to store information somewhere. RAM is for short term use only which means that when the system is switched off, anything in RAM is lost. Hard drives are therefore needed to store things permanently or over a longer term.
Mechanical hard drives tend to take a lot of time to spin up and fetch data whereas newer solid-state drives (SSDs) have no moving parts, so they're much quicker however they're also more expensive.

- **Ports**

Virtually all motherboards come with ports available for connecting peripheral devices such as USB ports (universal serial bus). These allow users to attach portable storage media or hardware to their system such as usb sticks, scanners, cameras, printers, etc.

- **RAM**

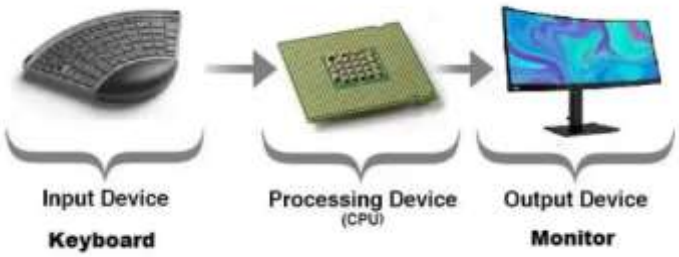
Random access memory (RAM) is a computer's internal, short-term memory. This memory is used by the operating system and all applications which are loaded in to memory for quick access. If the memory becomes full (i.e. if a user is running multiple, high performance applications) the system will swap between using RAM and storage on the hard disk drive which slows down performance. This is why increasing the amount of RAM in a system is usually the quickest way to improve performance in an older system.

- **Network Cards and Graphics Cards**

Wireless and wired networking cards enable a system to connect to the internet or a local network. These cards are plugged in to an expansion slot on the motherboard although most modern motherboards actually come with in-built NICs (network interface cards). The NIC itself typically houses the RJ45 (ethernet) port we're all familiar with.

- **OS processing device (with examples)**

The processing device is the computer's hardware component that helps to handle the storage and retrieval of the information. In the Computer, processing devices play major role in the processing operations. These devices are used to process the data with using of instructions from the program.



There is a list of different example of processing devices of computer

- GPU
- Microprocessors
- Sound Card
- Video Card
- CPU
- Clock

- Chipset
- Motherboard
- Data bus
- Expansion slots
- Address bus
- Random Access Memory

There is also a list of different example of processing devices of Mobile Phone:

- Central Processing Unit (CPU)
- Graphics Processing Unit (GPU)
- Memory
- Display
- Battery
- Camera
- Sensors

✓ Application of OS based processing devices

GPU

GPU stands for "**Graphics Processing Unit**" that is a computer integrated chip that helps to render the graphics and images with using of performing rapid mathematical calculation. GPU has responsibility for getting to render 2D and 3D images, video and animations.

- Due to high-computational ability of GPU, it is able to accelerate the machine learning.
- GPU allows to improve the performance for video editing and creation because parallel processing of a GPU is getting to render of graphic and video with high definition.
- Due to better performance of GPU, it is used in cryptocurrencies and bitcoin.
- GPU has two variants like as integrated and discrete. Integrated GPU is installed alongside the CPU, whereas discrete GPU is mounted on the separate circuit board

Microprocessor

Microprocessor is a heart of the computer that is installed as a single integrated circuit inside the computer. It has responsible for performing all arithmetic and logical operations.

Sound Card

Sound card is a **hardware component of computer** that is installed on the motherboard, and it delivers the audio input and output capabilities. Mostly, sound card has at least single analog line input and one stereo line output connection.

Video Card

Video card is an expansion card that is embedded on the **computer's motherboard**. Video card has other alternative names like as "**Display Adapter**", "**Graphics Card**", "**Video Adapter**", "**Video Board**", or "**Video Controller**". It is used to display the images on the **monitor** because without it, user would not able to see any pictures.

Mostly, gamer prefer the video card for getting extra processing power and high definition graphic.

CPU (Central Processing Unit)

CPU is a primary component of the **computer system** that helps to perform all types of data processing operations. It has responsible to manage operations of all components of computer.

Clock

Clock is used inside of the computer as a microchip that helps to regulate the timing and speed of the entire **computer' functions**. The computer processor's speed is also measured into clock speed like as 1 MHz is one million cycles and 2 GHz is two billion cycles.

System timer or system clock is getting regularly pulse that helps computer clock keep the accurate time.

Chipset

A chipset is a set of integrated circuit that helps to work together to deliver a single function and so manufactured and sold as a unit. For example – one chipset is a combination of all microchips, which are needed to provide the communications controller in between the **processor** and **memory** as well as other devices of the computer.

You can say that chipset helps to control the all flow of data throughout the computer.

Motherboard

Motherboard is the main circuit board of the computer system, and it is also called the "Main board or Logic board". Every motherboard consist the group of chip and controller known as chipset.

Data Bus

Data bus is installed on the **motherboard**, as well as it is group of wires that is used by CPU (Central Processing Unit) to transmit data in between all components of computer. It works like as device's engine. Data bus is also capable to transfer data in between two different computers.

Bus controllers help to regulate the speed at which all information is transferred in between all **computer parts**.

Each computer system has two types of data buses like as internal and external data buses.

Expansion Slots

An expansion slots refers to all slots which are installed on the motherboard, and they are used to embed the expansion card for expanding the computer's functionality such as video card, **network card**, or sound card.

Expansion cards can be inserted directly into expansion port so that the motherboard is directly able to access the computer hardware devices.

Few expansion slots are : PCI, AGP, AMR, CNR, ISA, EISA, and VESA

Network Card

Network card is a **hardware component of computer** that allows to make communication in between multiple computers through **local area network** (LAN). If, you want to make communication over large scale network then can be used Internet Protocol (IP).

It has other alternative name "**Network interface controller, network adapter or LAN adapter**".

Address Bus

Address bus is a group of wires that allows to store addresses only is the address bus. The address bus flows the data with uni-directional concept; it means that it can pass an address only one way, from CPU to **Random Access Memory** (RAM).

Main aim of address bus is to identify an address of location in the **primary memory**, where to be read from or written to. In the **main memory**, each location contains the own unique address, that is called as the "Addressability".

Random Access Memory

RAM (Random Access Memory) is the Primary memory of the computer.

Battery (mobile phone)

The battery provides power to the mobile phone, typically a rechargeable lithium-ion or lithium-polymer battery. Battery capacity is measured in milliampere-hours (mAh), with higher capacity batteries offering longer usage times.

Camera (mobile phone)

Smartphones feature multiple cameras, including rear-facing primary cameras and front-facing selfie cameras. Camera specifications include megapixel count, aperture size, sensor type, and additional features like optical image stabilization (OIS) and autofocus.

Sensors (mobile phone)
Mobile phones include various sensors that enhance functionality and user experience, such as:
-Accelerometer measures acceleration and orientation for screen rotation and motion-based controls
-Gyroscope detects device rotation and orientation for applications like augmented reality and gaming.
-Proximity Sensor detects the presence of objects close to the device, e.g., turning off the display during a phone call when held to the ear.
-Ambient Light Sensor measures ambient light levels to automatically adjust display brightness.

Indicative content 1.2: Preparation of workplace.

✓ **Cleaning techniques**

Cleaning: is the process of removing dirt, dust, stains, and contaminants from surfaces, objects, or environments to maintain hygiene, prevent the spread of germs, and promote a clean and safe living or working space.

- **Blowing**

cleaning using blower/blowing air on surface remove dirty,
This is cleaning technic that use mouth or a bellows to produce or emit a current of air. The purpose of air blowing is to remove loose scale and debris prior to start up using compressed air as the cleaning medium. The velocity of a large air mass through the pipeline will pick up any debris or loose scale left in the pipe.

- **Brushing**

remove (dust or dirt) by sweeping or scrubbing using a brush. This is cleaning methods that use brushes. Cleaning brushes use bristles, wire, or other filaments to dust, scrub, and remove deposits from objects and surfaces. They are commonly used to scrub and clean the work place, spot dust and clean, and remove metal, paint, and residue from equipment or wasted material

- **Toweling**:

wipe or dry with a towel, Toweling is the cleaning technics that use a kind of fairly thick soft cloth especially for making towels or removing the dust in workplace, repairing tools, equipment and materials.

✓ **Identification of Cleaning tools**

1. Vacuum cleaner: A vacuum cleaner, also known as a sweeper, is a device that uses an air pump (a centrifugal fan in all but some of the very oldest models), to create a partial vacuum to suck up dust and dirt, usually from floors, and from other surfaces such as upholstery and draperies. The dirt is collected by either a dust bag or a cyclone for later disposal.

2. Lags or cotton waste: Scraps of waste cotton yarn, used typically to clean machinery.
3. Cleaning solutions : Cleaning agents are substances (usually liquids, powders, sprays, or granules) used to remove dirt, including dust, stains, bad smells, and clutter on surfaces.
4. Brush: A brush is a tool with bristles, wire or other filaments, used for cleaning, grooming hair, make up, painting, surface finishing and for many other purposes.
5. Broom: is a cleaning implement for sweeping made of bundle of straws or twigs attached to a long handle.
6. Dustpan: is a cleaning tool commonly used to scoop the dirt and wastes on the floor.
7. **Bucket:** is a watertight, vertical cylinder or truncated cone, with an open top and a flat bottom, usually attached to a semicircular carrying handle that is used to hold water or any liquid solution used in cleaning.
8. Cobwebber is used for reaching and sweeping of floor without as tool. It is also used to in stairwells, ceiling corners and other high areas.
9. **Sponge:** is characterized by readily absorbing water and becoming soft when wet while retaining toughness: used in bathing, in wiping or cleaning surfaces, etc.

- ✓ **Safety rules and guidelines of electronic workshop**

safety rules and guidelines can be described as A principle or regulation governing actions, procedures or devices intended to lower the occurrence or risk of injury, loss and danger to persons, property or the environment.

- **Individual safety**

- Your safety is your personal responsibility.
- Always follow the correct procedures.
- Never take shortcuts.
- Clean and organize your workspace.
- Ensure a clear and easy route to emergency exits and equipment.
- Be attentive at all times to your work surroundings.
- When in doubt, contact your supervisor or manager for instruction, guidance, or training.
- Never take risks when it comes to safety.
- Obey safety signs, stickers(paper), and tags. (a small piece, cloth, material attached to something as a labor)
- Report serious injuries immediately to a supervisor and get emergency assistance.
- Keep things in perspective. Hazards may be limitless, so focus on the most likely risks first.

- **Operating safety**

- When entering workshop, pick up your hearing and eye protectors and immediately report to the workshop supervisor.
- When exiting the workshop, Check that any tools you have been using have been put away in the appropriate spots, cleaned up your work area and notify the workshop staff.
- Clothing & footwear: Students that wear glasses should be aware these are not safety glasses, they are only impact resistant and may shatter, safety glasses must be worn.
- All loose clothing (e.g. shirts hanging out) must be tucked in. Safety boots or enclosed shoes must be worn in the workshop. Do not enter under any circumstances without this footwear, there are no exceptions to this rule.

- Long hair has to be tied up including fringes.
- Remove rings and loose jewelry before operating machinery they can be a hazard.
- Eating and drinking in the mechanical workshop areas are strictly prohibited.
- Behavior, fooling around (lack good sense) and practical jokes (fun stories) in the workshop will not be tolerated.
- First Aid, all accidents, cuts and abrasions (damaged) must be reported before leaving the workshop. If an accident does happen, no matter how small, it must be reported to the workshop staff and an Accident
- Report Form filled out. Filling out this form is imperative for any future complications resulting from an accident.
- Fires or other emergencies, think before reacting to any emergency in the workshop, ensure you are reacting safely before you assist in an emergency. Do not attempt to fight any fire unless you have been trained to do so.
- Machinery usage, when students are operating machinery, all other students are to stay clear and not to talk to the operator. If you feel uneasy or unsafe operating any tools or machinery in the workshop, inform the workshop supervisor and help will be provided
- The gangway (narrow passages) through the workshop must be kept clear. Any oil spillage, grease etc. must be cleaned up immediately.
- Do not carry loads such that the weight may be dangerous or vision obscured.

Electrical safety

- Avoid water at all times when working with electricity. Never touch or try repairing any electrical equipment or circuits with wet hands. It increases the conductivity of the electric current.
- Never use equipment with frayed cords (loose threads), damaged insulation or broken plugs
- Always use insulated tools while working.
- Always use appropriate insulated rubber gloves and goggles while working on any branch circuit or any other electrical circuit.
- Never try repairing energized equipment. Always check that it is de-energized first by using a tester. When an electric tester touches a live or hot wire, the bulb inside the tester lights up showing that an electrical current is flowing through the respective wire. Check all the wires, the outer metallic covering of the service panel and any other hanging wires with an electrical tester before proceeding with your work.
- Do not use the electrical equipment or circuit of others.
- Try not to handle electrical appliances with wet hands, foot and on a wet floor.
- Never use highly flammable liquids near electrical equipment.
- Never underestimate the power of electricity: You would not like to underestimate (make to low estimate) the power of electricity in any condition. So always work with electricity carefully and pretend as the electricity flow is always there.
- Shut-off: Always make sure you have shut-off the power source before performing any work related to electricity. For example; Inspecting, Maintaining or repairing.

Indicative content 1.3: Selecting tools, materials, and equipment

✓ **Factors used to select tools and equipment**

Following are some of the factors to be considered while selecting appropriate tools, materials and equipment:

- Ease of Operation
- Flexibility
- Portability
- Adaptability
- Service
- Availability

Indicative content 1.4: Description of the diagnostic form of OS hardware-based devices

✓ **types of OS hardware-based devices diagnostic form**

Diagnostic form: Electronic diagnostic forms, in the context of hardware diagnostics, refer to digital or software-based tools used to record and analyze diagnostic information about electronic devices. These forms are often part of diagnostic software suites designed for identifying and troubleshooting hardware issues.

1. Security and Malware Diagnostic Form
2. Network and Connectivity Diagnostic Form
3. Performance and Optimization Diagnostic Form
4. Basic Hardware and OS Diagnostic Form
5. User Experience and Software Compatibility Diagnostic Form
6. Mobile Device Diagnostic Form

✓ **parts of OS hardware-based devices diagnostic form**

Hardware-based device diagnostic form for an operating system typically includes sections that gather information about the hardware components and their status. In these parts you might want to include:

1. Device Information:

- Device Type
- Serial Number
- Model
- Operating System
- OS Version
- User/Owner Information

2. Hardware Components:

- Processor (CPU):
- Details (Make, Model, Speed)
- Diagnostic Result (OK, Issues)
- Memory (RAM):
- Details (Capacity, Type)
- Diagnostic Result (OK, Issues)
- Storage:
- Details (Drive Type, Capacity)
- Diagnostic Result (OK, Issues)
- Graphics Card (GPU):
- Details (Make, Model)
- Diagnostic Result (OK, Issues)
- Motherboard:
- Details (Make, Model)
- Diagnostic Result (OK, Issues)

3. Operating System Check:

- Boot Process:
- Diagnostic Result (Normal, Slow, Error)
- System Updates:
- Last Update Date
- Diagnostic Result (Up to Date, Pending Updates)
- Software and Drivers:
- Diagnostic Result (Up to Date, Outdated)

4. Diagnostic Tests:

- CPU Stress Test:
- Result (OK, Overheating, Performance Issues)
- RAM Test:
- Result (OK, Errors Detected)
- Storage Health Check:
- Result (OK, Bad Sectors)
- Graphics Performance Test:
- Result (OK, Glitches, Low Performance)

5. Issues and Recommendations:

- Summary of Detected Issues
- Recommendations for Resolution

6. Technician Notes:

- Additional comments, observations, or notes from the technician

7. User Acknowledgment:

- Space for the user to acknowledge receipt of the diagnostic report

8. Timestamps:

- Date and time of each diagnostic test for reference

9. Digital Signatures:

- Technician Signature
- User Signature (acknowledging receipt)

10. Export and Reporting:

Options for saving or exporting the diagnostic report in various formats

This form provides a structured way to document hardware and operating system diagnostics. It helps technicians systematically go through various components, perform tests, and record results. Additionally, including user acknowledgment and timestamps adds accountability and a historical record of the diagnostic process

Learning outcome 2: Perform OS based devices maintenance activities

Indicative contents (headings of indicative content from the module of the curriculum)

2.1: Identification of common OS based devices' parts: for computer system and mobile phones

2.2: Applying testing techniques

2.3: Disassembling of OS based devices' hardware parts:

2.4: Applying troubleshooting techniques of OS hardware-based processing devices

2.5: Identification of frequent OS based processing device hardware faults

2.6: Applying repairing techniques

2.7: Re-assembling process of OS hardware-based devices

2.8: Applying functionality testing of OS hardware-based processing device

Duration: 50 hrs

Learning outcome 2 objectives:

By the end of the learning outcome, the trainees will be able to:

1. perform correctly Pre-disassembling tests according to Diagnostics techniques

2 Disassemble appropriately hardware parts of OS based processing devices according to the user manual.

2.3 Identify properly hardware OS based processing devices faults according to troubleshooting techniques.

2.4 Repair properly defective parts of hardware OS based processing devices according to repairing techniques

2.5 reassemble correctly hardware parts of OS based processing devices according to the reassembling process

2.6. apply properly functionality testing techniques according to the type of testing techniques.

Resources

Equipment	Tools	Materials
Digital multimeter, Air blower, Soldering station, Glue gun, Computer, PPE, Network Cable tester, LCD tester, Projector.	Screwdriver set, magnifying glass, soldering iron, Desoldering pump, Tweezer, Allen key set, ESD tools, plier sets.	Electronic components, Integrated circuits (IC), Electronic relay, Glue stick, Computer spare parts, Hard Disk Drive (HDD), Foam Cleaner, Thermal paste, Soldering paste, Desoldering wire, Soldering wire, marker pen

Advance preparation:

. Availability of repairing material, tools and equipment

. Proper preparation of working place

. Availability of electricity

Indicative content 2.1: Identification of common OS based devices' parts: for computer system and mobile phones

✓ **Processing parts**

There are a number of different computer processing devices kinds; identification of each is provided below.

- **GPU: Graphics Processing Unit,**

GPU is better suited to many parallel processes, designed for one specific use, Usually has hundreds of cores, Only important for some users.

- **Microprocessors**

A microprocessors are better for quickly processing a series of instruction, Designed to handle everything a computer does, it has an average of two to eight cores and it has long lifespan

- **Sound Card**

❖ **Video Card**

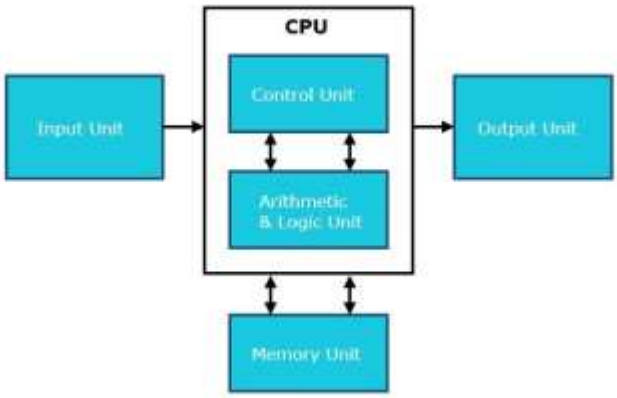
❖ **CPU**

Central Processing Unit (CPU) consists of the following features

- CPU is considered as the brain of the computer.
- CPU performs all types of data processing operations.
- It stores data, intermediate results, and instructions (program).
- It controls the operation of all parts of the computer.

CPU itself has following three components.

- Memory or Storage Unit
- Control Unit
- ALU(Arithmetic Logic Unit)



❖ **Clock**

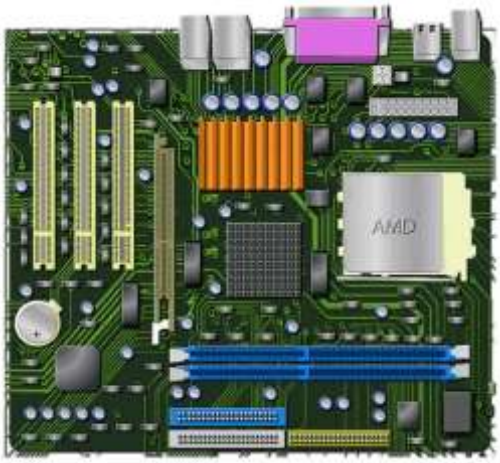
The usage of a clock as a microchip inside the computer aids in controlling the timing and speed of all of its operations.

❖ **Chipset**

An array of integrated circuits makes up a chipset that are created and offered as a unit and works as a team to perform a single function. For instance, a chipset is a collection of all the microchips that a computer needs to provide the communications controller between the processor and memory as well as other components.

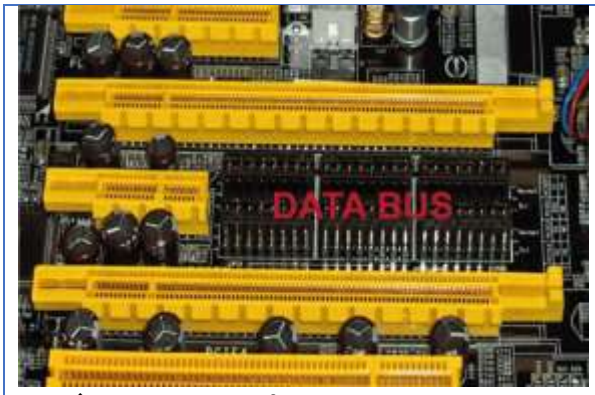
❖ **Motherboard**

The motherboard is the primary circuit board of the computer system, which is also known as the "Mainboard or Logic board". Every motherboard has a chipset, which is a collection of chips and controllers.



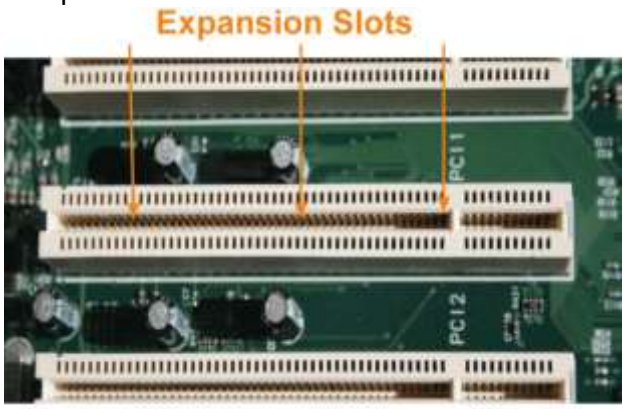
❖ **Data bus**

The *data bus* is a means of data transmission, which is a group of wires mounted on the motherboard and used by the *CPU (central processing unit)* to send data between all of the computer's components.



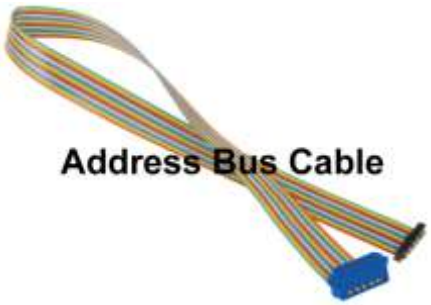
❖ **Expansion slots**

The term "expansion slots" refers to all motherboard slots that are used to insert expansion cards, such as video cards, network cards, or sound cards, to increase the capability of computers.



❖ **Address bus**

An address bus is a collection of wires that only permits addresses to be stored. The address bus has a unidirectional flow of data, which means that an address may only be passed in one direction, from the CPU to Random Access Memory (RAM).



❖ **Network Card**

The physical part of a computer, known as a network card enables local area network (LAN) connection between other computers.

❖ **Random Access Memory**

Mobile phone processing parts:

Below are main parts of the cell phone:

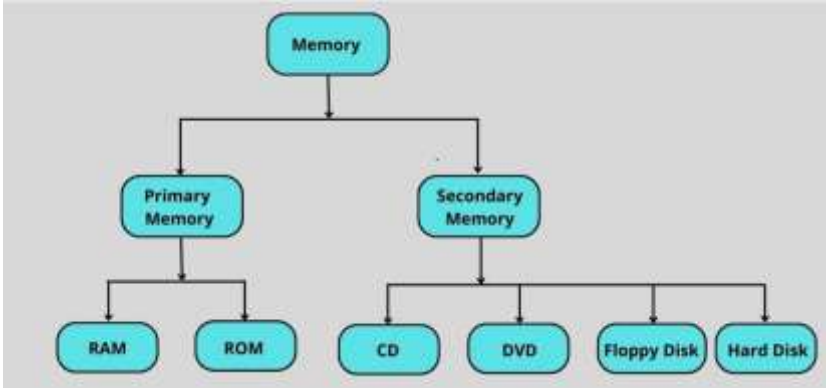
- Network section (Antenna Switch, P.F.O, RF IC, Network IC, 26 MHz Crystal Oscillator, RX Filter, TX Filter, VCO)
- Power section (Power IC, RTC, charging IC, CPU)
- Audio IC
- RAM
- UI module/ logic IC
- Peripheries interfaces (Microphone, speaker, screen and touch screen, vibrator, front and back camera, earpiece and antenna, and system charge connector)

✓ **Memory/Storage parts**

This unit can store instructions, data, and intermediate results. This unit supplies information to other units of the computer when needed. It is also known as internal storage unit or the main memory or the primary storage or Random Access Memory (RAM).

Its size affects speed, power, and capability.

Primary memory and secondary memory are two types of memories in the computer.



Functions of the memory unit are

- It stores all the data and the instructions required for processing.
- It stores intermediate results of processing.

- It stores the final results of processing before these results are released to an output device.
- All inputs and outputs are transmitted through the main memory.

✓ **Input/output port**

A connection point that acts as interface between the computer and external devices like mouse, printer, modem, etc. is called port.

Ports are of two types:

Internal port: It connects the motherboard to internal devices like hard disk drive, CD drive, internal modem, etc.

External port: It connects the motherboard to external devices like modem, mouse, printer, flash drives, etc.

Let us look at some of the most commonly used ports:

- **Serial Port**

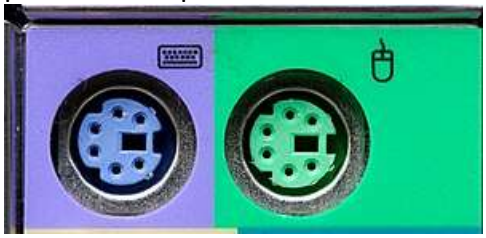
Serial ports transmit data sequentially one bit at a time. So they need only one wire to transmit 8 bits. However it also makes them slower.

- **Parallel Port**

Parallel ports can send or receive 8 bits or 1 byte at a time. Parallel ports come in form of 25-pin female pins and are used to connect printer, scanner, external hard disk drive, etc.

- **PS-2 Port**

PS/2 stands for Personal System/2. It is a female 6-pin port standard that connects to the male mini-DIN cable. PS/2 was introduced by IBM to connect mouse and keyboard to personal computers.



- **USB (Universal Serial Bus) Ports:**

Type-A: Standard USB port.
Type-B: Typically used for printers and scanners.
USB-C: A reversible, compact connector used for newer devices.

- **Audio Jacks:**

Headphone Jack: For connecting headphones, speakers or amplifiers.

- **HDMI (High-Definition Multimedia Interface) Port:**

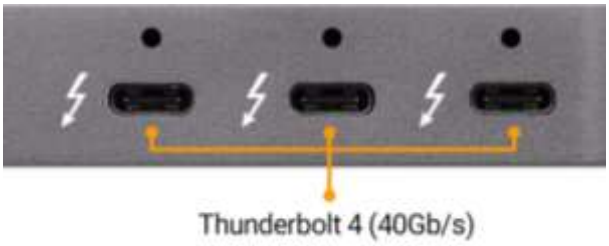
Used for connecting audio/video devices, such as monitors, TVs, and projectors.

- **VGA (Video Graphics Array) Port:**

Analog video connection for older monitors and projectors.

- **Thunderbolt Port:**

High-speed interface for connecting peripherals, external storage, and displays.



- **Ethernet Port:**

Used for wired network connections.

- **SD Card Reader:**

Allows reading and writing data to SD memory cards.

- **FireWire Port (IEEE 1394):**

Used for high-speed data transfer with compatible devices.

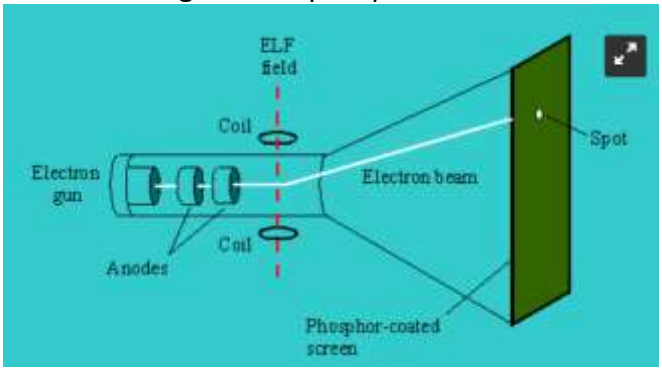
✓ **Display**

In computing, a display is a device with a screen that shows a rendered electronic image made up of pixels that are illuminated in a way that distinguishes text and graphic elements. Pixels are tiny areas of illumination (bright dots of light) that can number in the millions on a single display. Today, most displays use-colored pixels

In some computers, such as laptops or tablets, the display is integrated into the unit, along with the processor and other computer components. In other computer systems, such as desktops, the display is packaged in a separate unit called a monitor, which is connected to the computer either directly or indirectly over a network.

The types of displays

Cathode ray tube (CRT). Although seldom used today, the CRT was at one time the dominant type of display used in computing. Based on the same technology originally used in televisions, CRTs are big, bulky and consume a lot of power. This bulkiness is due in large part to the CRT technology, which requires a certain distance from the beam projection device to the screen to function. The CRT is made up of a large vacuum tube that uses electron beams to generate an image on the phosphorescent surface of the screen.



Liquid crystal display (LCD). The LCD is a type of flat-panel display that is much thinner and lighter than the CRT. To generate an image, the LCD uses liquid crystal sandwiched between two panes of polarized glass, with a backlight illuminating the glass. LCDs work by blocking light rather than creating it. The display's pixels are switched on or off electronically as the liquid crystals rotate the polarized light. Because of its thinner profile and lower power consumption, LCDs have replaced CRTs for most computing needs.

Light-emitting diode (LED). An LED display is a type of LCD that uses a set of LEDs as its light source, rather than the types of backlights (often cold cathode fluorescent lamps) used for LCD displays. LED technology is generally smaller and lighter than the original LCD. A newer type of LED is the organic LED (OLED), which uses an organic polymer as the semiconductor material. And a more recent type of LED is the quantum dot LED (QLED), which incorporates a layer of nanoparticles to improve colour and luminance.

Characteristics of display:

- **Display size:** The display size is the diagonal length of the screen from one corner of the screen to the opposite corner.

- **Aspect ratio:** This measurement is the ratio that compares an image's width and height. Many of today's displays have an aspect ratio of 16:9, which is the same as high-definition television (HDTV). Aspect ratios have varied over time as technologies evolved.
- **Resolution:** The resolution is the number of pixels displayed on the screen, typically measured in terms of width and height. The higher the resolution, the better the image detail. For example, a resolution of 1920 x 1080 (1080p) offers better quality than 1280 x 720 (720p).
- **Pixel density:** The pixel density refers to the number of pixels per inch (ppi). The ppi is based on the display size and resolution. For example, a 14-inch screen with a resolution of 3024 x 1964 has a 258 ppi, but a 17-inch screen with the same resolution has only a 212 ppi. If the ppi gets too low, the display quality will suffer.

- **Refresh rate**. Measured in hertz (Hz), the refresh rate is the number of times the display is completely refreshed in a second. The higher the refresh rate, the smoother the transitions between shifting images. Refresh rates typically range from 60 Hz to 120 Hz. Some displays offer higher refresh rates, but those generally target specific use cases, such as advanced graphics or gaming.
- **Image technology.** This will primarily come down to choosing one of the available types of LCD or LED display.
- **Connectivity.** DisplayPort is generally favored over HDMI for computer monitors, with DVI usually considered a third choice. (Connections such as Thunderbolt and USB-C typically support DP connectivity.) VGA is seldom a consideration.

✓ Interface

Interfaces are tools and concepts that technology developers use as points of interaction between hardware and software components. They help all components within a system communicate with each other via an input-output system and detailed protocols while also allowing them to function independently.

Interfaces also help users interact with various types of devices through hardware devices like keyboards, mice and touch screens and software programs like operating systems or internet protocols.

➢ **TYPES OF INTERFACES**

1. **Hardware interfaces:** Hardware interfaces help various hardware devices connect and communicate with each other. Some common hardware interfaces in computing are:

- USB (universal serial bus) interfaces
- Serial interfaces
- Parallel interfaces
- PCI and PCI-Express interfaces
- IEEE 1394 interface

2. **Software interfaces:** They enable all coding relationships between a computing device's software applications, allowing these elements to interact effectively. They also manage and control the relationships between software applications and the hardware supporting them.

Some examples of software interface include:

- Operating systems:
- Simple Mail Transfer Protocol (SMTP) email
- IP network protocols
- Software drivers:

3. **User interfaces:** They facilitate all manual interactions between users and hardware or software, supporting the overall functionality of these systems. They may also help make complex operations more accessible with the help of intuitive graphic designs. Some examples of user interface include:

- Command-line interface
- Graphical User Interface (GUI):
- Menu-driven interface:
- Conversational user interface

✓ DAC/ADC

DAC (Digital-to-Analog Converter) and ADC (Analog-to-Digital Converter) are crucial components in the field of electronics, especially in the context of signal processing. They are used to convert signals between digital and analog formats.

DACs and ADCs are integral in bridging the gap between the analog and digital domains, allowing electronic systems to interact with the physical world. An ADC samples the analogue signal at regular intervals, quantizes each sample into a digital value, and then represents these values as binary numbers. The resulting digital data can be processed, stored, or transmitted by digital systems.

DAC (Digital-to-Analog Converter):

DAC converts digital signals into analog signals.

DACs are commonly used in audio systems, music players, communication devices, and any application where digital signals need to be converted to analogue for output to speakers or other analogue devices. A DAC takes a series of binary numbers (digital signals) and converts them into an analog voltage or current signal. This analog signal is then used to represent the original information in a continuous form.

✓ Power supply unit

Abbreviated as PS or P/S, a power supply or PSU (power supply unit) is a hardware component of a computer that supplies all other components with power. The power supply converts a 110-115 or 220-230 volt AC (alternating current) into a steady low-voltage DC (direct current) usable by the computer and rated by the number of watts it generates.

The power supply is located at the back of the computer, usually at the top, In a desktop computer case (all-in-one), the power supply is located at the back left or back right.

Below are parts you may find on the back of the power supply.

- A connection for the power cord to the computer.
- A fan opening to heat out of the power supply.
- A red switch to change the power supply voltage.
- A rocker switch to turn the power supply on and off.

On the front of the power supply, which is not visible unless the computer is opened, you find several cables. These cables connect to the computer motherboard and other internal components.

Below are parts inside a power supply.

- A rectifier that converts AC (alternating current) into DC.
- A filter that smooths out the DC (direct current) coming from a rectifier.
- A transformer that controls the incoming voltage by stepping it up or down.
- A voltage regulator that controls the DC output, allowing the correct amount of power, volts or watts, to be supplied to the computer hardware.

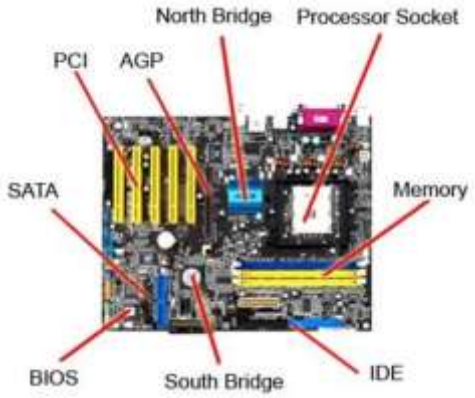
✓ **Main board**

A motherboard is the main printed circuit board (PCB) in a computer. The motherboard is a computer's central communications backbone connectivity point, through which all components and external peripherals connect.

Motherboards can be found in virtually all computers, especially desktop and laptop PCs. The components that connect through them include chipsets, central processing units (CPU) and memory. The external peripherals include Wi-Fi, Ethernet and graphics cards with the graphics processing unit, or GPU.

Motherboard components

Each motherboard is designed to support specific components, such as CPUs and memory. They can accommodate most types of hard drives and peripherals.



Motherboards include the following primary components:
CPU with its logic circuitry that processes the instructions from programs, the operating system and other computer components;
memory where instructions and data are temporarily stored and executed;
storage interface for solid-state or hard disk drive for persistent data and application storage;
ROM BIOS providing non-volatile memory that stores firmware, such as the basic input/output system or BIOS;
Northbridge chipset that connects CPU, memory, storage and other components;
Southbridge chipset that connects peripheral elements to the motherboard and connects to the Northbridge;
cooling fans that maintain a suitable internal operating temperature;
peripheral connector slots for plugin peripheral cards, such as graphics and communications adapters;
connectors for peripheral devices such as USB ports and other connectors for external devices;
the backup battery that ensures key system configuration data is maintained when main power is unavailable; and
the power connector, connecting to an external power source.

- **hardware components of mobile devices**

The hardware components of mobile devices are similar to that of computer. They include Central Processing Unit (CPU), batteries, Random Access Memory (RAM), Read Only Memory (ROM), removable storage such as memory cards, input components such as mouthpiece or keyboard, and output components such as earpiece or screen.

Indicative content 2.2: Applying testing techniques

When testing OS based devices, it's important to let the equipment first warm up thoroughly to ensure stable performance. Our first step in testing is to turn on it and make sure it will stay on continuously by disabling any settings that might turn it off or put it in an idle (or sleep) mode. Technically we can apply the following techniques to test all components of OS based device, each test can be applied based on the parameter that will going to be measured or component will be going to be tested.

- ✓ **Continuity testing**

In electronics, a continuity test is the checking of an electric circuit to see if current flows (that it is in fact a complete circuit). A continuity test is performed by placing a small voltage (wired in series with an LED or noise-producing component such as a piezoelectric speaker) across the chosen path. If electron flow is inhibited by broken conductors, damaged components, or excessive resistance, the circuit is "open". Devices that can be used to perform continuity tests include multimeters which measure current and specialized continuity testers which are cheaper, more basic devices, generally with a simple light bulb that lights up when current flows. An important application is the continuity test of a bundle of wires so as to find the two ends belonging to a particular one of these wires; there will be a negligible resistance between the "right" ends, and only between the "right" ends.
Test continuity with a Digital Multimeter, follow the following steps:

- Adjust the dial to the meter continuity (the little speaker) function.
- Plug the test leads into the suitable terminal.
- Touch the component under test using the leads
- The DMM beeps under good continuity that allows the flow of current. If no continuity exists, the DMM does not beep.

- ✓ **Voltage measurement**

Instruments for measuring voltages include the voltmeter, the potentiometer, and the oscilloscope. Analog voltmeters, such as moving-coil instruments, work by measuring the current through a fixed resistor, which, according to Ohm's Law, is proportional to the voltage across the resistor. The potentiometer works by balancing the unknown voltage against a known voltage in a bridge circuit. The cathode-ray oscilloscope works by amplifying the voltage and using it to deflect an electron beam from a straight path, so that the deflection of the beam is proportional to the voltage. To measure voltage is to determine the “differential” voltage between two separate points in an electrical circuit. For example, to measure the voltage across a single resistor, you measure the voltage at both ends of the resistor. The difference between the voltages is the voltage across the resistor. Usually, differential voltage measurements are useful in determining the voltage that exists across individual elements of a circuit, or if the signal sources are noisy.

Follow the following steps for Measuring Voltage:
To start, let’s measure voltage on a AA battery: Plug the black probe into COM and the red probe into mAVΩ. Set the multimeter to “V” in the DC (direct current) range. Almost all portable electronics use direct current), not alternating current. Connect the black probe to the battery’s ground or ‘-’ and the red probe to power or ‘+’.
Here is a step-by-step guide on how to use a multimeter to test for voltage:

- First, figure out whether the application being testing utilizes AC or DC voltage. Afterward, adjust the meter dial to the suitable function to DC Voltage or AC voltage.

- Adjust the range to the number little higher than the predictive value. If the value being measured is unknown, then set the range to the maximum available number.

- Plug in the test leads into the common (black) and voltage (red) terminals.
- Apply the leads to the test circuit.
- Position and reposition the test till a dependable reading appears on the meter LCD.
- While measuring AC voltage, variations may happen in the reading. As the test continues the measurement will steady.

✓ **Current measurement**

Current can be measured using an ammeter. Electric current can be directly measured with a galvanometer, but this method involves breaking the electrical circuit, which is sometimes inconvenient. Current can also be measured without breaking the circuit by detecting the magnetic field associated with the current. There are two main ways to measure current one is based on electromagnetics and is associated with the early moving coil meter, and the other is based on the main theory of electricity, Ohm's law.

✓ **Electronic components testing**

Repairing an electronic device begins with testing these electronic components through multimeter. Multimeters can measure resistance, current, voltage capacitance and identification of transistor pinout such as NPN and PNP. They can test devices powered by either AC or DC voltages and work in or out of circuit.

✓ **Functionality testing**

Functional testing is defined as a type of testing which verifies that each function of the device/circuit operates in conformance with the requirement specification. It is performed by feeding input to the circuit/device and test/measure the output. Functional testing is conducted to evaluate the compliance of a system or component with specified functional requirements. Functional testing usually describes what the system does.

Indicative content 2.3: Disassembling of OS based devices' hardware parts:

✓ **Disassembling process of laptops and desktops**

When referring to hardware, to disassemble is to break down a device into separate parts. A device may be disassembled to help determine a problem, to replace a part, or take the parts and use them in Another device or sell them individually. To disassemble is to take something apart or to break it down into pieces.

Disassembling process of laptops and desktops

- Unplug your computer and peripheral items
- Remove side covers
- Disconnect connectors
- Remove standalone fans
- Remove the storage drive
- Remove memory (RAM) modules
- Remove power supply unit
- Remove motherboard adapter or expansion cards
- Remove the motherboard

✓ **Disassembling process of various mobile phones: feature phones, smartphones**

- Removal of back cover
- Removal of battery
- Removal of SD card and SIM card
- Unscrew the back housing
- Disconnect various peripheries
- Removal of the motherboard
- Removal of screen and touch screen

Indicative content 2.4: Applying troubleshooting techniques of OS hardware-based processing devices

✓ **Test and replace**

Test and replace

Hardware failures most certainly may occur in your computer, it is important to check for as many software issues as you can before proceeding. The fact is, most errors are caused by software (such as drivers) related problems, not by a failing hardware device.

A good starting point to troubleshoot hardware comprises the following:

- Computer HDD (hard disk drive).
- Computer RAM (random-access memory).
- Computer motherboard & CPU (central processing unit).

- Computer PSU (power supply unit).
- Computer CD/DVD disc drives.
- Computer network, Wi-Fi, or Internet.

1. **Computer HDD (hard disk drive).**

A bad hard drive can cause an assortment of different issues on your computer. Below are some possible issues you may encounter. It is important to remember that the issues below can also be caused by more than a bad disk drive.

- Errors when reading, copying, moving, or deleting data on the computer.
- Extremely slow.
- Operating system unable to boot.
- Other random errors or computer reboots.

2. **Computer RAM (random-access memory)**

Bad memory can cause an assortment of different issues on your computer. Below are some possible issues you may encounter. It is important to remember that the below issues can also be caused by more than bad memory.

- Computer does not boot, and you are getting a beep code.
- Random computer crashes causing BSoD, general protection fault error messages, illegal operations, fatal exceptions, etc.
- Random computer reboots.
- Software installation failure.

3. **Motherboard &CPU**

A bad computer motherboard or CPU (central processing unit) can cause an assortment of different issues on your computer. Below are some possible issues you may encounter. It is important to remember that the issues below can also be caused by more than a bad motherboard and CPU.

- Computer does not boot, instead you get a beep code.
- Random computer crashes causing general protection fault error messages, illegal operations, or fatal exceptions, etc.
- Computer randomly reboots.

There are different ways to test and troubleshoot your computer's motherboard and CPU to determine if it's bad or has flaws. Below is a listing of these recommendations:

- Visual hardware check
- Software and hardware solutions
- Replace the motherboard and CPU

4. **Computer PSU (power supply unit)**

If you have a desktop computer that does not turn on after pressing the power button, use the following information and troubleshooting steps to help fix the problem:

- Ensure the computer is turning on
- Power cord not connected properly
- Bad power cable
- Power supply switch
- Incorrect power supply
- Bad power supply, button, power board, or inverter
- Loosely connected hardware
- Bad motherboard or other bad hardware components

5. CD/DVD disc drives

A bad CD-ROM (compact disc read-only memory) or other disc drive can cause an assortment of different issues on your computer. Below are some possible issues you may encounter. It is important to remember that the issues described below can also be caused by more than a bad disc drive:

- Error when reading CD or DVD.
- CDs or DVDs may not play audio or video properly.
- CD or DVD programs may not install or encounter errors after being installed.

6. Network, Wi-Fi, or Internet

because of the variety of network hardware, network configurations, operating systems, and setups, not all the following information may apply to your network or operating system:

- Adapter resources (Verify that the network adapter is installed correctly and detected by the computer with no conflicts)
- Verify connections (Wired network & Wireless)
- Adapter functionality (Verify the network card can ping itself using the ping command)
- Connect to the router (If your network has a router, make sure the computer is connecting to the router with commands.)
- Firewall

✓ **Sequential troubleshooting**

Troubleshooting a hardware OS processing device involves identifying and resolving issues that may arise during its operation. Here's a sequential guide you can follow:

- **Check Physical Connections:**

Ensure that all cables and connections are secure. This includes power cables, data cables, and peripheral connections.

- **Power Supply:**

Verify that the power outlet is functional. Test with another device if possible. Ensure the power supply to the computer is stable.

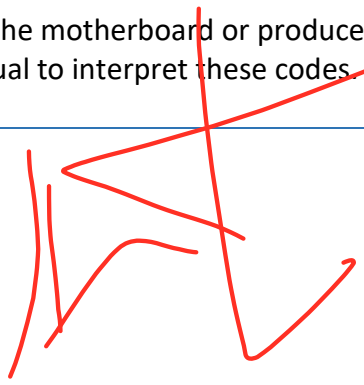
- **Power Button:**

Check if the power button is working. Sometimes, a faulty power button can prevent the computer from turning on.

- **Diagnostic LEDs or Beeps:**

Some computers have diagnostic LEDs on the motherboard or produce beep codes during startup. Refer to your motherboard's manual to interpret these codes.

- **Check for Display Issues:**



If there's no display, check the monitor, cables, and graphics card. Try connecting to a different monitor or use a different cable.

- **RAM (Memory) Issues:**

Reseat the RAM modules. If you have multiple modules, try booting with each one individually to identify a potentially faulty module.

- **CPU and Motherboard**:

Check for any physical damage to the CPU or motherboard. Reseat the CPU if possible.

- **Disconnect External Devices:**

Disconnect all unnecessary external devices (printers, external hard drives, etc.) and try booting again.

- **Boot in Safe Mode:**

If you can access the operating system, try booting in safe mode. This can help identify if a third-party driver or software is causing the issue.

- **Check for Software Issues:**

Run antivirus and anti-malware scans to check for potential infections. Ensure that the operating system and drivers are up-to-date.

- **Update Drivers:**

Ensure that all drivers, especially graphics and chipset drivers, are up-to-date. Outdated drivers can cause compatibility issues

Indicative content 2.5: Identification of frequent OS based processing device hardware faults

Identification of frequent computer hardware faults

- ✓ **Memory faults**
  - Computer is slow
  - OS booting doesn't load
- ✓ **Hard Disk Drive**

Some common symptoms of impending disk failure include:

- Strange noises such as clicking or humming from **the drive**.

- Repeated program crashes or **disk** errors.
- Frequent **error** messages while running software.
- Overall strange behavior from **the** computer
- Computer is slow
- Computer doesn't start

✓ **CPU faults**

Symptoms of a CPU failure

- Lock ups and **overheating** immediately before PC shuts down. ...
- Beeping. ...
- Charred motherboard or CPU. ...
- Heat. ...
- Aging. ...
- Undue stress or overclocking. ...
- **Power** surge or unstable voltage. ...
- Bad motherboard
- Computer is slow
- Computer doesn't start

✓ **PSU fault**

Common power-related symptoms include:

- Any **power**-on or system startup **failures** or lockups.
- Spontaneous rebooting or intermittent lockups during normal operation.
- Intermittent parity checks or other memory-type errors.
- HDD and fan simultaneously **failing** to spin (no +12V)
- Overheating due to fan **failure**.
- No start

✓ **Network card faults**

- No internet connectivity

✓ **Video card faults**

- No video displayed
- No graphics

✓ **Sound card faults**

- No sound

✓ **Motherboard faults**

- Computer keeps restarting

✓ **Cooling system faults**

- Overheating
- Computer keeps restarting

✓ **Computer port faults**

Identification of frequent mobile phone hardware faults

✓ **Network fault**

- There is no network at all in the phone.
- There is less or weak network signal.
- Sometimes there is signal and sometimes there is no network signal.
- There is network signal for some time and then there is no signal at all.

✓ **Memory faults**

✓ **Power management IC faults**

- **Power on failure**

This may be caused by:

- Dead battery
- Corrupted initialization/boot sector files due to virus or improper usage
- Damaged Operating System software
- Failed power switch
- Damaged battery terminals
- Damaged power IC or microprocessor chip.

- **Battery charging faults**

This may be caused by:

- External charging Adapter
- Internal charging port
- Motherboard charging sub-circuit.

✓ **Sound faults**

Sound faults occurs in the components below:

- **Speaker faults**
  - The user will not hear from the other end of conversation completely
  - The user can barely hear the caller's voice from another end
  - The voice signal from the other end will be cranky, stifled by noisy interface
- **Microphone faults**
  - The user will hear from the other end of conversation but not be heard
  - The user can barely be heard by the caller on the other end

- The voice signal transmitted to the other end will be cranky, stifled by noisy interface on the component surrounding the microphone

Ringer Faults

The ringer or loudspeaker is the devices for sound alert, music and other notification to user. When they become faulty it may be caused by:

- The user will not hear the ringtone when called by the another cellphone
- The device rings but the user barely hear the sound from the other end or other multimedia and notification sounds are very low.
- The sound signal from the phone will be cranky, stifled by noisy interface

Vibrator faults

When the vibrator fails to work, disassemble the phone and replace it.

✓ **Displaying faults**

- Mobile Phone Display Not Working (*Phone Dead*)
- Nothing shows on the Display or Display is Black / Blank
- Display Broken or Crack
- Sometimes Display Works and Sometimes it doesn't work
- There is only light in the Display and nothing else
- Touch Screen Not Working

✓ **SIM card faults**

- SIM is inserted but still there is a message saying "*Insert SIM*".
- The Mobile Phone goes OFFLINE when the SIM Card is inserted.
- SIM works for some time and then it stops working.
- There is a message that says "*Invalid SIM*".
- SIM Card Not Working.
- SIM Card Not Detected in any Phone.
- Android Phone Can't Detect SIM Card
- SIM Access Error

Indicative content 2.6: Applying repairing techniques

Repairing computer hardware involves troubleshooting and fixing issues related to physical components. Here are some common hardware repairing techniques:

- Visual Inspection
- Hardware Diagnostics:
  - Power Supply Issues
  - Memory (RAM) Issues
  - Hard Drive Troubleshooting
  - Graphics Card Issues
  - Peripheral Connectivity
  - Power Management Issues
- Documentation
- Professional Assistance
- Soldering and disordering electronic components

A typical printed circuit board, or PCB, contains a large number of electronic components. These components are held on the board by solder flux that creates a strong bond between the pins of a component and their corresponding pads on the board. However, the main purpose of this solder is to provide electrical connectivity. Soldering and desoldering is performed to install a component on a PCB or to remove it from the board.

- **Soldering**

Soldering is a process used for joining metal parts to form a mechanical or electrical bond. It typically uses a low melting point metal alloy (solder) which is melted and applied to the metal parts to be joined and this bonds to the metal parts and forms a connection when the solder solidifies.

- **Desoldering**

If a part that has been soldered needs to be replaced it needs to be “de-soldered”. Depending on the part and type of joint it may be possible to simply re-melt the solder and remove the part, or it may be necessary to remove the solder from the joint so the part can be freed.

Indicative content 2.7: Re-assembling process of OS hardware-based devices

To re-assemble is to fit together all the separate pieces in order to form one whole.

The following are the Steps and techniques of computer re- assembling:

- Prepare the computer case
- Install the motherboard
- Attach the components on the motherboard
- Install adapter cards
- Connect all internal cables
- Install the power supply
- Boot the computer for the first time
- Configure BIOS

The following are the Steps and techniques of cell phone re-assembling:

- Assembling the screen and touch screen
- Fixing the screen and touch screen in the front housing
- Connecting various peripheries (Microphone, speaker, screen and touch screen, vibrator, front and back camera, earpiece and antenna, and system charge connector)
- Fixing the back housing
- Inserting battery, SD and SIM cards
- Fixing the back cover

Indicative content 2.8: Applying functionality testing of OS hardware-based processing device

✓ **Functional testing**

Functional testing verifies that each function of the device operates in conformance with the requirement specification, ensuring that electrical and electronic products comply with the regulation requirements or with the specific requirements defined by the client. The following are functionality testing methods:

- POST (Power On Self Testing)
- Power supply testing
- Keyboard / mouse testing
- Ports testing
- Beeps decoding
- Hardware testing
- Comparison Testing

✓ **Performance testing**

Performance testing is a testing measure that evaluates the speed, responsiveness and stability of a computer, network, software program or device under a workload. Below is some types of performance testing.

- CPU Performance Testing.
- GPU Performance Testing.
- RAM (Memory) Performance Testing.
- Storage Performance Testing.
- Motherboard and Chipset Performance Testing.
- Network Performance Testing.
- Power Supply Testing.
- Cooling System Performance Testing.
- Peripheral Performance Testing.
- Overall System Performance Testing.
- BIOS/UEFI Update Testing.

Learning outcome 3: Perform post-maintenance activities

Learning outcome 3: Perform post-maintenance activities.

Indicative contents (headings of indicative content from the module of the curriculum)

3.1: Applying OS based processing devices for preventive maintenance

3.2: Identification of waste material disposal techniques

3.3: Reporting and handover the work.

Duration: 10 hrs

Learning outcome 3 objectives

By the end of the learning outcome, the trainees will be able to:

1. Provide clearly recommendation to the user as per hardware preventive maintenance operations and maintenance form

2. Manage correctly wastes according to waste disposal procedures

3. handover correctly repaired device according to handover activities.

Resources

Equipment	Tools	Materials
Digital multimeter, Air blower, Soldering station, Glue gun, Computer, PPE, Network Cable tester, LCD tester, projector	Screwdriver set, Magnifying glass, Soldering iron, Desoldering pump, Tweezer, Allen key set, ESD Tools, plier set, OS device Repair Tool Kit	Electronic components, Integrated circuits (IC), Electronic relay, Glue stick, Computer spare parts, Hard Disk Drive (HDD), Foam Cleaner, Thermal paste, Soldering paste, Desoldering wire, Soldering wire, marker pen

Advance preparation:

. Availability of cleaning tools and equipment.

. Proper preparation of working place

. Availability of electricity

Indicative content 3.1: Applying OS based processing devices for preventive maintenance

- ✓ **OS based device security: for computers and mobile phones**
- **Security threat**

A threat is a possible danger to the system. The danger might be a person (a system cracker or a spy), a thing (a faulty piece of equipment), or an event (a fire or a flood) that might exploit a vulnerability of the system.

- **Description of security threat**
- **Virus Threats**

a computer virus is a program written to alter the way a computer operates, without the permission or knowledge of the user. A virus replicates and executes itself, usually doing damage to your computer in the process.

- **Spyware Threats**

A serious computer security threat, spyware is any program that monitors your online activities or installs programs without your consent for profit or to capture personal Information

- **Social Engineering**

Tricking computer users into revealing computer security or private information,
Example passwords, email addresses, etc, by exploiting the natural tendency of a person to trust and/or by exploiting a person's emotional response.

- **Keyloggers**

Keyloggers record every keystroke made on a computer to steal serial numbers for software, to launch internet attacks, to gain access to e-mail accounts, to obtain passwords to protected computer systems, or to pick up personal information such as credit card numbers.

- **Bacteria**

Are programs that do not explicitly damage any files.

Their sole purpose is to replicate themselves Bacteria reproduce exponentially, ventually taking up all the processor capacity, memory, or disk space, denying users' access to those resources.

- **Denial-of-service**

Attack that prevents authorized user from accessing the system.

- **Worms**

Independent computer programs that copy themselves -unlike viruses- from one computer to other computers over a network. This explains why computer worms spread much more rapidly than computer viruses. Worms destroy data and programs as well as disrupt or even halt the operation of computer networks.

- **Anti-virus software for OS based hardware device security**

Anti-virus software is a program or set of programs that are designed to prevent, search for, detect, and remove software viruses, and other malicious software like worms, trojans, adware, and more.
Examples of anti-virus: Avast, Norton antivirus, Macfee, avira , Kaspersky,AVG ……etc.

- ✓ **OS based device performance optimization: for computers and mobile phones**

Device performance optimization: Performance optimization is the process of improving the speed, efficiency, and reliability of devices by using various techniques and tools. Optimizing device performance for computers and mobile phones involves a combination of hardware and software adjustments.
Strategies for Optimizing Performance on Computers and Mobile Devices

- **Clear Storage Space**

One of the common causes of sluggish device performance is limited storage space.

- Regularly reviewing and deleting unnecessary files, applications, and media can free up storage capacity and improve performance.
- Start by going through your documents, downloads, and desktop folders to remove any files that are no longer needed.
- Additionally, check your applications and uninstall any unused or redundant software.
- Utilize built-in tools like Disk Cleanup (Windows) or Storage Management (iOS and Android) to identify and remove unused files that may be taking up valuable space.

- **Update Operating System and App**

Ensuring that your operating system and applications are regularly updated is vital to maintain optimal performance. Developers frequently release updates that include bug fixes, security patches, and performance enhancements. These updates not only improve the overall functionality of your device but also address any existing issues that may be affecting its performance.

- Enable automatic updates on your device to ensure that you receive the latest updates as soon as they are available.
- Alternatively, you can regularly check for available updates manually.
- By staying up to date, you can ensure that your device is running on the latest software version, which can enhance stability, security, and overall efficiency.

- **Manage Startup Programs**

When your computer or mobile device starts up, several programs and processes may automatically launch in the background, consuming valuable system resources. This can lead to slower boot times and reduced overall performance.

- Take the time to review the list of startup programs and disable any unnecessary ones to speed up boot times and improve performance.
- On Windows, utilize the Task Manager's Startup tab to manage startup programs.
- On macOS, navigate to:
  - System Preferences
  - Users & Groups
  - Login Items.
- On mobile devices, explore options to disable auto-start or limit background processes in the app settings.

By minimizing the number of programs running at startup, you can free up system resources and significantly enhance the responsiveness of your device.

- **Optimize System Settings**

Fine-tuning system settings can have a substantial impact on performance.

- Adjust visual effects and animations to reduce the strain on your device's CPU and GPU.
- On Windows, access the Performance Options in the Control Panel to customize visual effects and adjust power settings. Disable or reduce unnecessary visual effects such as transparency or animation.
- On macOS, go to:
  - System Preferences
  - Accessibility
  - Display and enable "Reduce motion" to minimize unnecessary animations.
- On mobile devices, disable unnecessary animations and limit background processes in the developer options.

These optimizations can result in smoother multitasking, faster response times, and extended battery life. By optimizing system settings, you can create an environment that maximizes the efficiency of your device.

- **Perform Regular Maintenance**

The technical meaning of computer maintenance involves operational and functional checks, servicing, repairing or replacing, if necessary, devices, equipment, machinery, and supporting utilities. Over time, this has come to often include both scheduled and preventive maintenance as cost-effective practices to keep computer equipment ready for operation at the utilisation stage of a system lifecycle.
There are two basic types of maintenance

Corrective maintenance: In computing corrective maintenance is a maintenance task performed to identify, isolate, and rectify a fault so that the failed equipment, machine, or hardware system can be restored to an operational condition within the tolerances or limits established for in-service operations.
Preventive maintenance (PM): The care and servicing by personnel for the purpose of maintaining computer equipment in satisfactory operating condition by providing for

systematic inspection, detection, and correction of incipient failures either before they occur or before they develop into major defects. Computer Preventive maintenance tends to follow planned guidelines regularly to prevent equipment and machinery breakdown.

Regular maintenance tasks are essential to ensure the smooth operation of your device over time.

- For computers, consider defragmenting your hard drive (Windows) or optimizing storage (macOS) to organize files and improve data access times. Fragmented files can significantly slow down your system, so performing regular maintenance can have a positive impact on overall performance.
- On mobile devices, clearing app caches and temporary files periodically can help free up storage space and enhance responsiveness.
- Additionally, running regular antivirus scans can detect and remove any malware that may be affecting performance.

Keeping your device clean and optimized can prevent performance degradation over time and provide you with a seamless and efficient user experience

- **Upgrade Hardware**

If you've tried all the software-based optimization techniques and are still experiencing sluggish performance, it may be time to consider upgrading your device's hardware.

- Adding more RAM, upgrading to a solid-state drive (SSD), or replacing an aging battery can significantly improve performance. RAM provides the necessary memory for your device to run applications smoothly, while an SSD can drastically reduce boot times and file access speeds.
- replacing aging battery with a new one can ensure that your device maintains optimal performance and battery life.

Indicative content 3.2: Identification of waste material disposal techniques

✓ **Types of waste material**

Waste (or wastes) are unwanted or unusable materials. Waste is any substance which is discarded after primary use, or is worthless, defective and of no use.

❖ **Types of waste materials**

Recyclable waste:

Recycling is the process of converting waste materials into new materials and objects. The recyclability of a material depends on its ability to reacquire the properties it had in its virgin or original state. Recyclable rubbish includes all waste items that can be converted into products that can be used again. Solid items such as paper, metals, furniture and organic waste can all be recycled.

Bio-degradable waste

A biodegradable material can be defined as a material which can be decomposed by bacteria or other natural organisms and not be adding to pollution. Biodegradable wastes are such waste materials which are and can be degraded by natural factors like microbes (e.g. bacteria, fungi and few more), Some examples of such wastes are food materials, kitchen wastes, and other natural wastes. Microorganisms and other abiotic factors together break down complex substances into simpler organic matters which eventually suspend and fade into the soil. Biodegradable waste can be commonly found in municipal solid waste as green waste, food waste, paper waste, and biodegradable plastics. Other biodegradable wastes include human waste, manure, sewage, slaughterhouse waste.

Non-bio-degradable waste

Non-biodegradable substances are materials which do not degrade easily. As they are synthesized and do not occur naturally, degradation is impossible with these products. Therefore, when they stay in the ecosystem for a long period and do not decompose, they harm our environment. For instance, plastics, chemicals, rubber, paints, batteries, metals and all fall in this category.

✓ **Techniques of waste material management**

Waste treatment refers to the activities required to ensure that waste has the least practicable impact on the environment. Whether it is biodegradable or non-biodegradable, they harm human life and ruin other organisms and their environment. Thus, a proper treatment of wastes has to be done. This is not only the responsibility of Government, and each can contribute.

The three Rs- are simplest steps which can take by each person

Recycle

Reuse

Reduce.

Indicative content 3.3: Reporting and handover the work.

✓ Preparation of technical reports

After making the repair of OS based device, you should prepare the document that describe your full working activity from the begging up to the end of work.

That report document must describe all the work you have been carried out, including the following:

- Faulty parts
- Type of fault
- tools, materials and Equipment used
- steps and Techniques used to fix the fault
- Status of the computer peripheral after work

A well written report will demonstrate your ability to:

- understand the purpose of the report brief and adhere to its specifications;
- gather, evaluate and analyse relevant information;
- structure material in a logical and coherent order;
- present your report in a consistent manner according to the instructions of the report brief;
- make appropriate conclusions that are supported by the evidence and analysis of the report;
- make thoughtful and practical recommendations where required.

✓ Elements of technical report

The following are the main elements that characterize the technical work-related document:

- Repairing date
- Addresses of technician
- Status of devices parts
- Name of the repaired parts
- Work carried out
- Recommendation

✓ Analysis of the previous work document

Analysis of the previous work document

It is very recommended to review the previous work document of device you want to repair Before starting the repairing activities, thus will help you to analyses the previous fault, it's cause and the way have been solved, using previous work document.

You can identify and analyse the following helpful parameters:

- Previous faults
- Previous used Techniques
- Previous status of the computer peripheral
- Previous recommendation

Resources

Tools	Screwdriver set, Allen keys, cutting plier,
Equipment	Digital multimeter, Air blower, Soldering station, Glue gun, Personal Computer, Personal protective equipment (PPE) kit.
Materials/ Consumables	Heat sink, Thermal paste, cooling fan

Assessable outcomes	Assessment criteria (Based on performance criteria)	Indicator	Observation		Marks allocation
			Yes	No	
1. Perform pre-maintenance activities	1.1 The workplace is well prepared according to the electronic workshop standards	The workplace is cleaned			3
		Workshop rules are l respected			3
	1.2 Tools, materials, and equipment are well selected according to activities to be done	Adequate tools, materials, and equipment is selected			3
		Tools, materials, and equipment are arranged			3
	1.3 The testimony of device's owner is well recorded based on the diagnostic form	Diagnostic techniques are performed			3
		The diagnostic form is completed			3
2. Perform maintenance activities	2.1 The hardware of OS based processing devices is well maintained according to the preventive maintenance techniques	Preventive maintenance techniques are applied			4
	2.2. Pre-disassembling tests are correctly performed according to Diagnostics techniques	The fault is analysed			4
		Testing techniques are performed			4

	2.3 The hardware parts of OS based processing devices are Disassembled according to the user manual	The cover is removed using the appropriate tools			4
		Proper labelling and disconnection techniques are applied			4
		OS hardware-based device health and safety precautions are respected			4
	2.4 The hardware of OS based processing devices faults is identified according to troubleshooting techniques	Adequate testing techniques (cold and hot testing) are applied			4
		Adequate testing / measuring tools or instruments are used			4
		Testing/measuring tools or instruments are correctly calibrated			4
	2.5 The defective parts of hardware of OS based processing devices are properly repaired according to repairing techniques and components specifications	Di-soldering/removal of defective parts is performed			4
		Device/components ratings and specifications are respected			4
		New components are soldering or fitted in			4
	2.6 The hardware parts of OS based processing devices are reassembled according to the user manual	Reassembling process is respected			4
		Hardware of OS based device is correctly reassembled			4

	2.7. The functionality testing techniques are properly applied according to the type of testing techniques	The expected output is observed			4
		Functionality testing is performed			4
3. Perform post-maintenance activities.	3.1. The workplace is properly rearranged as per electronic workshop standards	Tools, materials and equipment are rearranged based on the types			2
		Tools, materials and equipment are rearranged based on the size			2
		Tools, materials and equipment are rearranged based on their use			2
	3.2. The wastes are correctly managed according to waste disposal procedures	waste materials are rearranged based on biodegradable			2
		waste materials are rearranged based on non-biodegradable			2

3. Perform post-maintenance activities.	3.1. The workplace is properly rearranged as per electronic workshop standards	Tools, materials and equipment are rearranged based on the types			2
		Tools, materials and equipment are rearranged based on the size			2

		Tools, materials and equipment are rearranged based on their use			2
	3.2. The wastes are correctly managed according to waste disposal procedures	Waste materials are rearranged based on biodegradable			2
		waste materials are rearranged based on non-biodegradable			2
		The workplace is l cleaned			2
	3.3. The repaired device is correctly handed over	Technical report format is respected			2
	according to handover activities	Repair steps contents are followed			2
		Technical recommendations are provided			2
		Cost estimation is done based on the reality			2
		Invoice format is respected			2
Total marks					
Percentage Weightage		100%			
Minimum Passing line % (Aggregate): 70%					

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